

# Geology 12

## June 1998 Provincial Examination

### ANSWER KEY / SCORING GUIDE

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- Topics:**
1. Earth Materials
  2. Time and Fossil Record
  3. Internal Structures and Processes
  4. Surficial Processes
  5. Comparative Planetology

#### Part A: Multiple Choice

Q	K	C	T	PLO	Q	K	C	T	PLO
1.	A	U	1	B2, 3	29.	A	U	3	K1
2.	D	U	1	B3, E2	30.	A	U	3	K4
3.	B	U	1	B2, 3	31.	D	U	3	K5
4.	D	H	1	E2, 3	32.	D	U	3	K7
5.	C	U	1	C2, 4	33.	A	U	3	L3
6.	A	H	1	D1	34.	A	U	3	L4
7.	B	U	1	D2	35.	C	K	3	L1
8.	C	U	1	C3	36.	A	U	3	L1
9.	B	U	1	A6	37.	D	H	3	N1
10.	D	U	1	C6, 7	38.	C	K	3	N1
11.	A	K	1	C4	39.	A	K	3	N3
12.	C	U	1	C7	40.	B	U	3	M1
13.	B	H	1	F2	41.	B	K	3	N3
14.	A	U	1	F2	42.	D	U	3	O5
15.	B	U	1	F4	43.	B	U	3	O7
16.	D	H	1	F4	44.	C	U	3	O6
17.	C	K	1	F3	45.	C	U	4	Q2
18.	A	U	2	G2	46.	D	U	4	Q1, 2
19.	D	K	2	G4	47.	C	U	4	Q4
20.	D	U	2	G5	48.	A	U	4	R1
21.	C	H	2	H2	49.	D	K	4	R2
22.	C	U	2	H3	50.	D	H	4	S2
23.	B	H	2	H4	51.	B	K	4	S1
24.	B	K	2	I1	52.	B	U	4	P3
25.	B	H	2	G4	53.	D	U	5	T1
26.	B	K	2	J3	54.	D	U	5	T2
27.	D	U	2	J6	55.	C	K	5	T3
28.	C	K	2	J5					

**Multiple Choice = 55 marks**

**Part B: Written Response**

<b>Q</b>	<b>B</b>	<b>C</b>	<b>T</b>	<b>S</b>	<b>PLO</b>
1.	1	H	1	8	A4, 5 / C / D1 / E / P
2.	2	U	1	2	C1, 2 / E2, 4, 5
3.	3	H	1	3	F3, 4, 5, 7
4.	4	U	2	5	J, 1, 2, 5, 6
5.	5	U	2	2	G2 / J6
6.	6	U	2	2	H1, 3 / J3
7.	7	H	3	4	K1, 3, 4, 6, 7
8.	8	U	3	4	L2, 3, 4, 5, 6
9.	9	U	3	2	M1
10.	10	U	3	4	O1, 3, 4, 9
11.	11	U	4	3	R1
12.	12	U	4	4	P1, 2
13.	13	U	5	2	T3

**Written Response = 45 marks**

Multiple Choice = 55 (55 questions)

Written Response = 45 (13 questions)

**EXAMINATION TOTAL = 100 marks**

**LEGEND:**

**Q** = Question Number

**B** = Score Box Number

**PLO** = Prescribed Learning Outcome

**K** = Keyed Response

**S** = Score

**C** = Cognitive Level

**T** = Topic

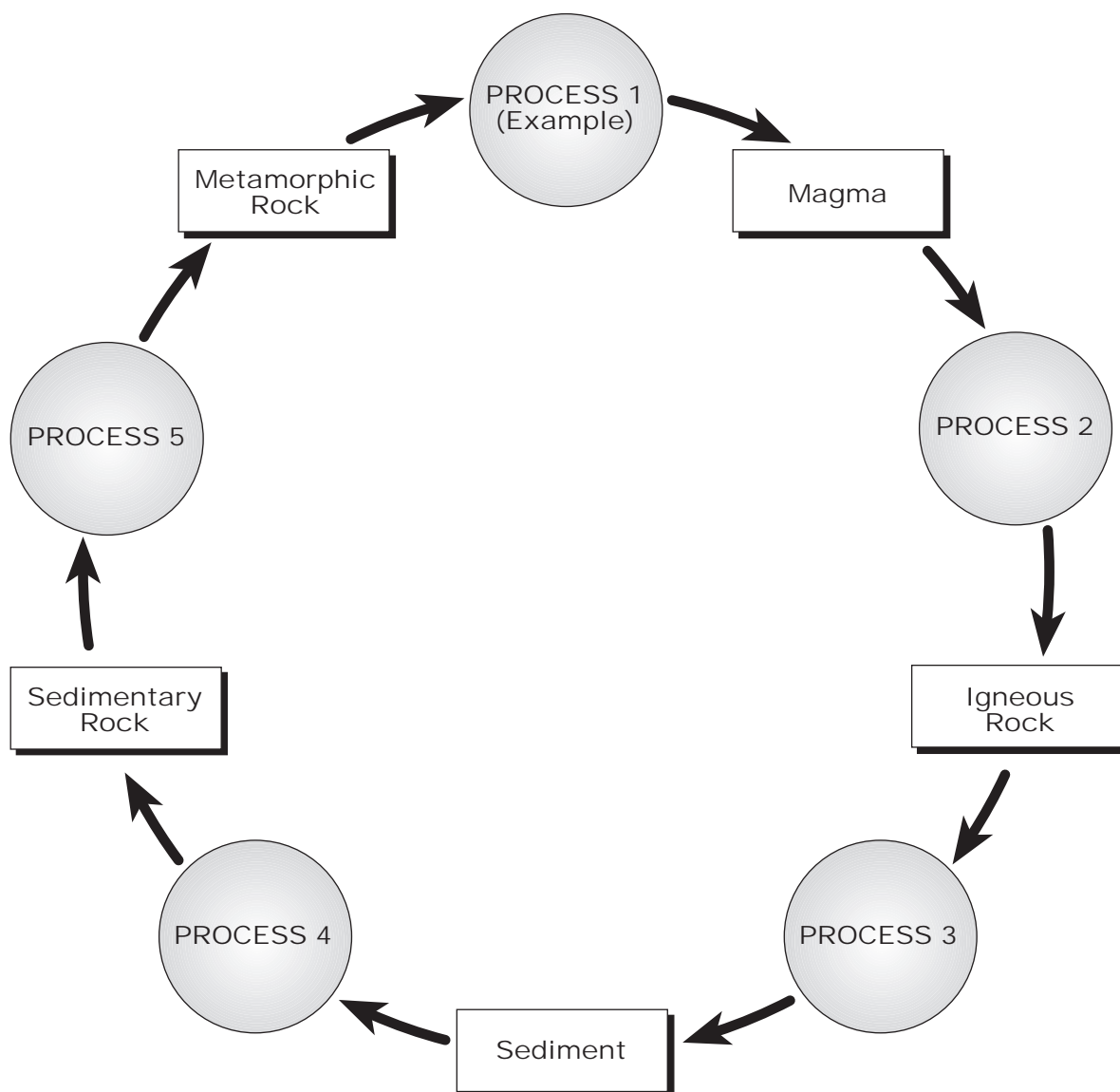
## PART B: WRITTEN RESPONSE

Value: 45 marks

Suggested Time: 55 minutes

**INSTRUCTIONS:** Answer each question in the space provided. You may not need to use all of the space given.

Use the following partial, simplified, rock cycle diagram to answer question 1.



1. The diagram shows the major classes of earth material that are part of the rock cycle. Complete the following chart, in detail, by naming and describing four of the major processes which drive the rock cycle. Give details about the geological environment where each process would occur.

	<b>Name and description of the process</b>	<b>Geologic details about the environment where the process would occur</b>
<b>EXAMPLE</b> PROCESS 1	<b><i>Fusion and Melting</i></b> <i>The rock has been heated to such a high temperature that it has started to melt.</i>	<i>The process occurs deep in the earth's crust or in the upper mantle where the temperature is sufficient for melting.</i>
a) PROCESS 2	<i>Magma rises up through the crust and cools, solidifies and crystallizes. Some magma may emerge as lava and solidify on the surface.</i> <b>(1 mark)</b>	Lower crust, upper crust and surface of the earth. May cool in batholiths, dikes, sills, volcanoes. <b>(1 mark)</b>
b) PROCESS 3	<i>Physical and chemical weathering and erosion during transportation break down the solid rock to sediment. The sediments are usually eventually deposited in marine environments.</i> <b>(1 mark)</b>	These processes occur on the earth's surface where the rocks are exposed to surface processes. <b>(1 mark)</b>
c) PROCESS 4	<i>Lithification.</i> Sediments are buried, compacted and cemented. <b>(1 mark)</b>	Just below the earth's surface in areas where the sediment is buried. Large deltas would be the most important environment for the formation of sedimentary rocks. <b>(1 mark)</b>
d) PROCESS 5	<i>Metamorphism.</i> As any type of rock is subjected to an increase in temperature and/or an increase in pressure, it is likely to recrystallize to form a metamorphic rock. Contact metamorphism occurs when intruded rock is heated by intruding magma. <b>(1 mark)</b>	Within the earth, where the temperatures and pressures are sufficient to make the minerals recrystallize. Metamorphism usually accompanies mountain building. <b>(1 mark)</b>

2. a) Describe **one** change you would expect to see in the fossiliferous limestone due to contact metamorphism near the granite intrusion. (1 mark)

Any **one** of the following:

- **Fossils destroyed by metamorphism.**
- **Limestone has recrystallized to a granulate texture (marble).**
- **Limestone has lost porosity.**

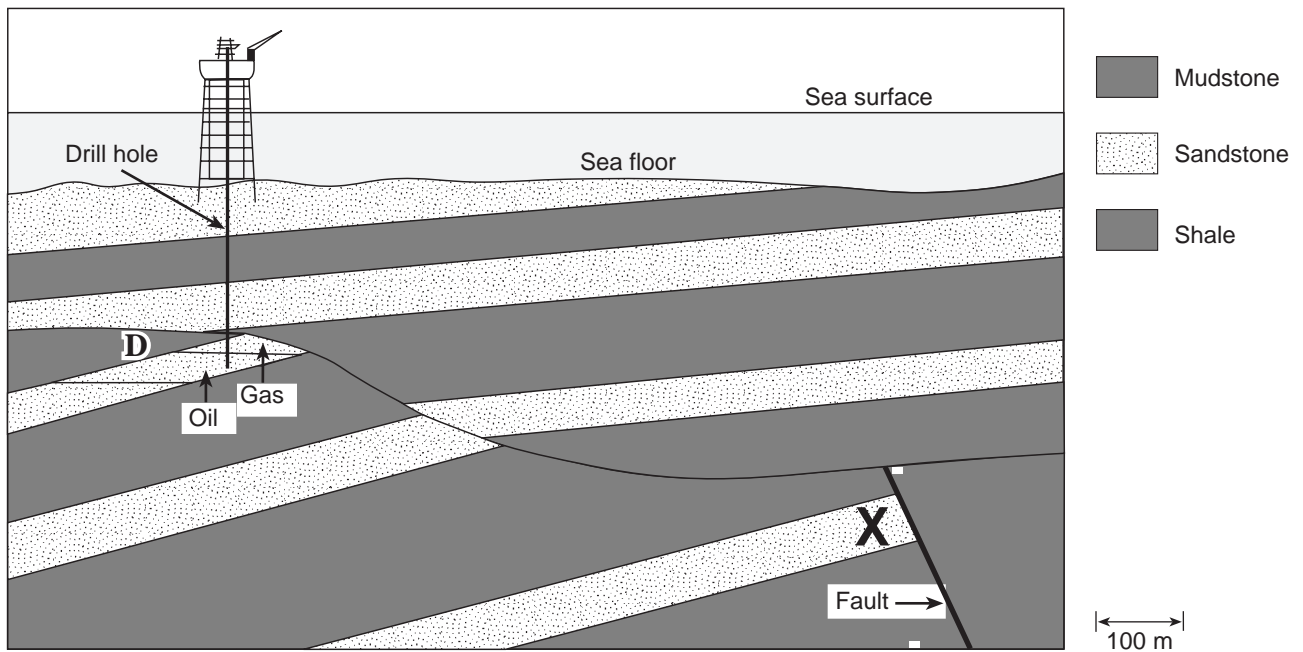
} ← 1 mark

- b) What changes in crystal size would be observed by a geologist as she walked the 200 metre section from **X** to **Y** across the granite? (1 mark)

**Moving away from the sedimentary country rock (from X to Y), the crystals in the granite batholith would get larger.**

} ← 1 mark

Use the following diagram of a cross section through an oil-gas field to answer question 3.



3. a) Explain how oil and gas have been trapped near D. Refer to the permeable and impermeable rocks in your answer. (1 mark)

- The oil and gas have migrated from their source rocks up the permeable sandstone layer, confined by overlying shale. } ←  $\frac{1}{2}$  mark
- The oil and gas have been trapped where they encountered the impermeable mudstone layer. } ←  $\frac{1}{2}$  mark

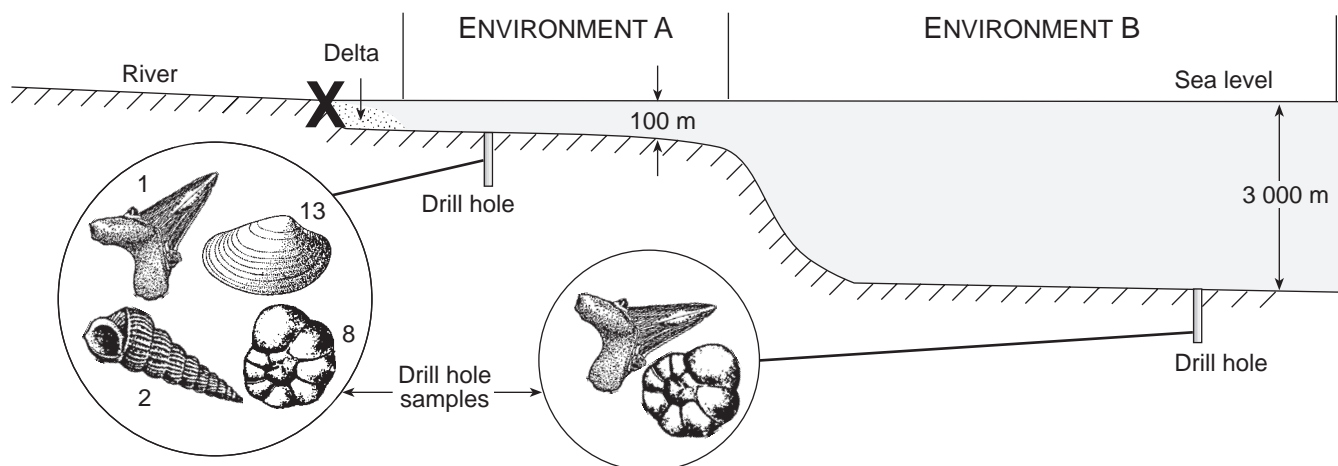
- b) Place an **X** on **one other** location on the cross section where oil and gas would likely be found. Assume that the rock layers continue past the edges of the diagram. (1 mark)

See diagram.

← 1 mark

c) Many substances of great economic value are obtained from crude oil deposits. Name **one** substance that is obtained directly from crude oil and describe what it is used for. **(1 mark)**

SUBSTANCE	USE OF SUBSTANCE
$\frac{1}{2}$ <b>mark</b> for any <b>one</b> of the following: <b>Gasoline</b> <b>Diesel fuel</b> <b>Aviation fuel</b> <b>Fuel oil</b> <b>Natural gas</b> <b>Paraffin wax</b> <b>Lubricating oil</b> <b>Grease</b>	$\frac{1}{2}$ <b>mark</b> for any <b>one</b> of the following: <b>Automobile engines</b> <b>Diesel truck engines</b> <b>Propeller-driven aircraft, jet aircraft</b> <b>Heating systems</b> <b>Heating, engines</b> <b>Candles</b> <b>Lubrication</b> <b>Lubrication</b>



4. The sketch shows a profile of a river delta, continental shelf and abyssal plain, at the edge of a continent. Drill hole samples taken in environment A contain large quantities of fossils 1, 2, 8 and 13. Samples from drill holes in environment B contain large quantities of fossils 1 and 8.

a) Give **one** reason why fossils 1 and 8 are found in **both** environments. (1 mark)

**Fossils 1 and 8, in both environments, are from free-swimming organisms and could have been preserved anywhere.**

} ← 1 mark

- b) Place an **X** on the profile where a ginkgo leaf (fossil 18) would **most likely** be preserved as a fossil. Explain why you have chosen that location. (2 marks)

**See diagram. X should be in the river or the delta, not a distance out on the shelf and certainly not on the abyssal plain.**

} ← 1 mark

Any **one** of the following:

- The leaf is delicate and would not survive much transport.
- The leaf would probably rot quickly in the ocean.
- The leaf is from a land plant and could not be transported further than the delta.
- Fine sediments deposited in the delta would allow good preservation.

} ← 1 mark



c) Give **two** conditions that favour the fossilization of marine organisms.

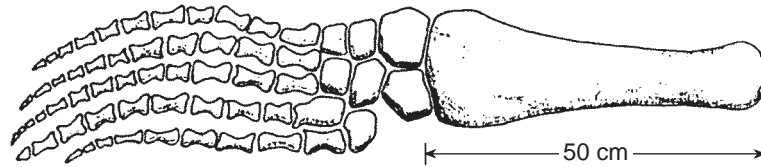
**(2 marks)**

Any **two** of the following:

- **Rapid burial.**
- **Fine sediments.**
- **Hard parts such as shell.**
- **Large numbers of organisms.**

} ← **2 marks**

Use the following diagram of a fossilized forelimb to answer question 5.



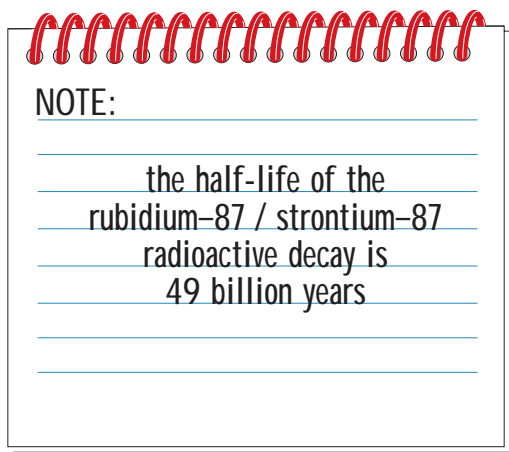
5. Making reference to the fossil above, describe how the Principle of Uniformitarianism is used to discover the lifestyle of the organism. **(2 marks)**

**For full marks:**

- The student should compare the bone structure to those of modern animals and assume that the fossil's lifestyle was similar.
- Looks like a flipper from a seal or similar animal.
- Finger-like bones do not look like grasping fingers. They look more paddle-like.
- Looks like a flipper so may be used for swimming.

← 2 marks

Refer to page ii of the Data Booklet.  
Use the Fossil Samples and the following information to answer question 6.

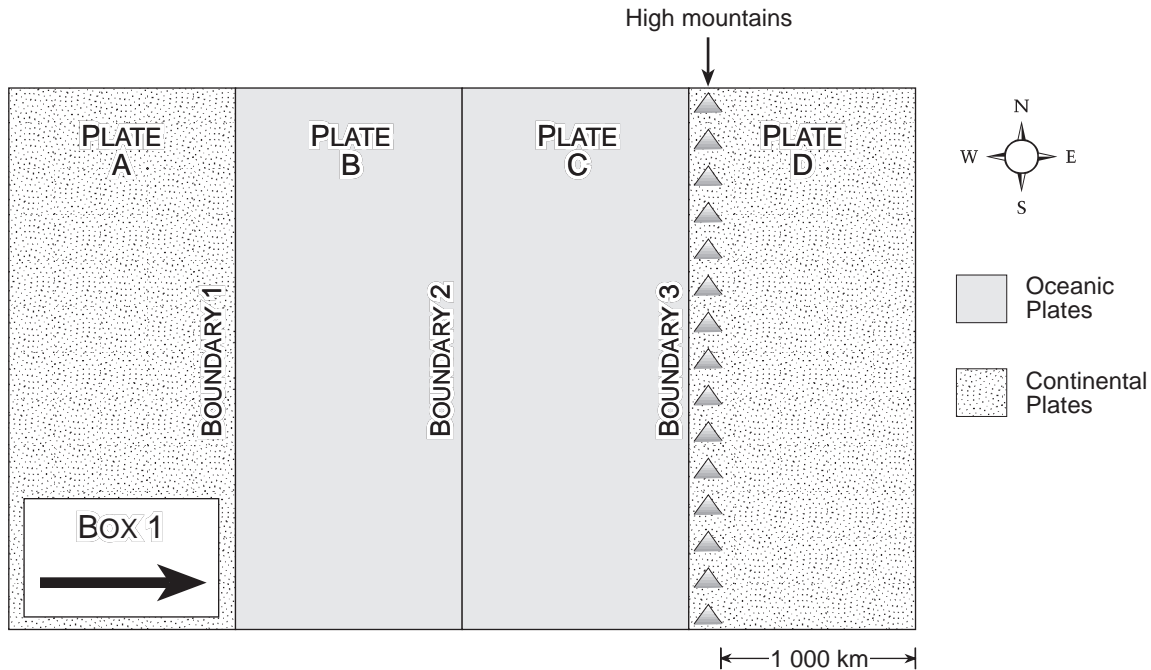


6. The Miocene fossil (#13) is preserved as a cast. The age was determined using the rubidium-87/strontium-87 radiometric dating system technique. Give **two** reasons why the estimated radiometric age of the original organism might be inaccurate. **(2 marks)**

Any **two** of the following for **two marks**:

- Reason 1: **Because of long half-life, there may not be enough daughter product to provide an accurate date.**
- Reason 2: **Because it is a cast, one cannot date the original organism.**
- Reason 3: **Cast material may contain insufficient rubidium-87 to give an accurate date.**

Use the following diagram of four lithospheric plates to answer question 7.  
All the plates are moving.



7. a) Boundary 1 is a convergent boundary. Indicate with an arrow in Box 1 on the diagram the direction that Plate A must be moving relative to Plate B. (1 mark)

Direction of Plate A: **See diagram. Plate A must be moving east.**

← 1 mark

- b) A chain of high mountains lies on Plate D. Name **two** geologic processes which could contribute to the formation of this mountain chain on Plate D. (2 marks)

Geologic Process 1: **Subduction or convergence.**

← 1 mark

Geologic Process 2: **Uplifting, folding, volcanism.**

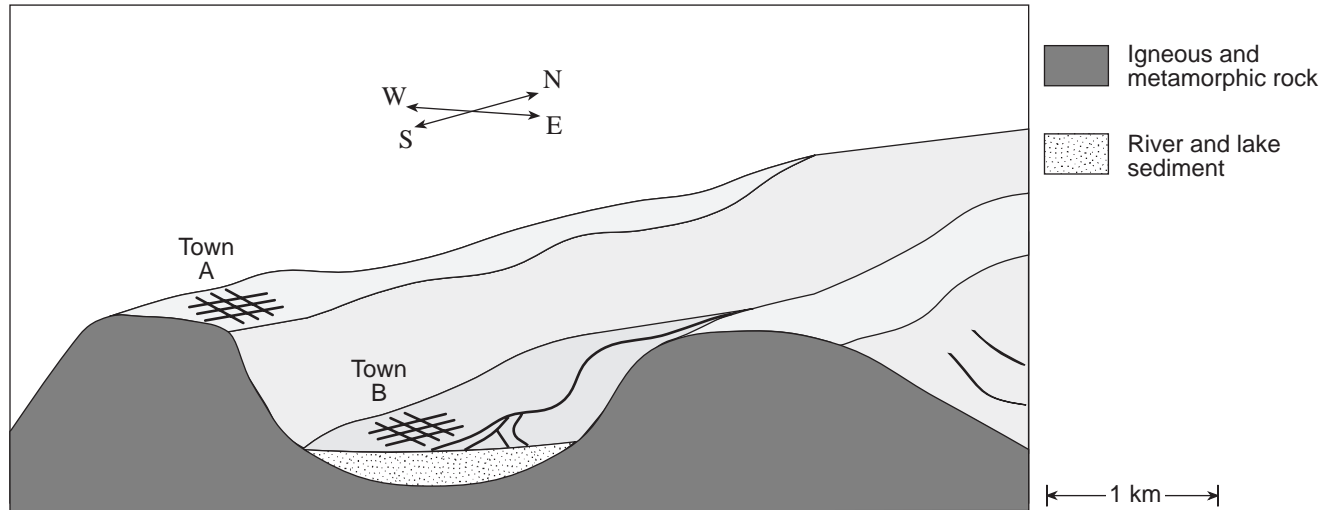
← 1 mark

- c) What geologic feature would need to be located at Boundary 2 to account for the relative motion of these four plates? (1 mark)

**Spreading centre/spreading ridge/rift zone.**

← 1 mark

Use the following cut-away diagram of an area which has experienced a magnitude 6 earthquake to answer question 8.



8. The area shown in the diagram above experienced a magnitude 6 earthquake. The focus was located 30 km beneath Town B. Town B was more extensively damaged than Town A, even though both towns have the same construction standards, and have similar populations.

a) Which town is likely to have a higher Mercalli Scale rating?

(1 mark)

**Town B is likely to have a higher Mercalli Scale rating.**

← 1 mark

b) What is the **most likely** reason for the extensive damage to Town B?

(1 mark)

**The extensive damage to Town B is likely the result of the shaking and liquefaction of the lake and river sediments and the fact that Town B is closer to the focus of the earthquake than Town A.**

← 1 mark

c) The P-wave and S-wave travel-time difference at Town B is slightly less than at Town A. Explain why this travel-time difference would occur.

(1 mark)

**The P-S travel-time difference at Town B is slightly less than at Town A because Town B is closer to the focus.**

← 1 mark

d) The people of Town B did not act on the advice of a local seismologist who noticed a variety of earthquake warning signs (precursors) prior to the earthquake. Describe **one** such precursor that the seismologist may have detected.

(1 mark)

**Radon gas in well water, bulging, micro-quakes, rock resistivity changes, P-wave velocity change, unusual animal behavior.**

← 1 mark

9. There are areas in Canada where the land is rising. There are a number of reasons why this may occur. For example, the west coast of Vancouver Island is being uplifted due to plate tectonic processes and the Hudson's Bay region is being uplifted due to isostatic processes. Describe each of these processes.

a) Plate tectonic uplift of the west coast of Vancouver Island.

(1 mark)

**The subduction of the Juan de Fuca plate under the North American plate is causing the tilting of Vancouver Island.**

} ← 1 mark

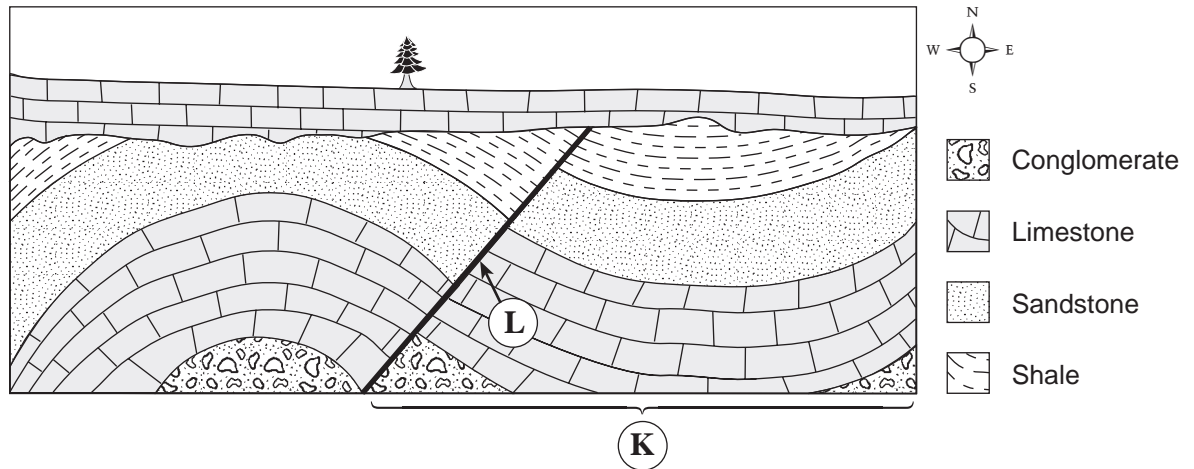
b) Isostatic uplift of the Hudson's Bay region.

(1 mark)

**As the glaciers recede, the weight of the crust is reduced and the rock/land rebounds.**

} ← 1 mark

Use the following cross section to answer question 10.



10. a) What is the name of the type of fault labelled **L**?

(1 mark)

**Fault L is a normal fault.**

← 1 mark

b) What type of forces (compressional, tensional or sheer) would have produced a fault of this type?

(1 mark)

**Fault L would be caused by stretching, tensional forces on the crust.**

← 1 mark

c) What is the name of fold type **K**?

(1 mark)

**Fold type K is a syncline.**

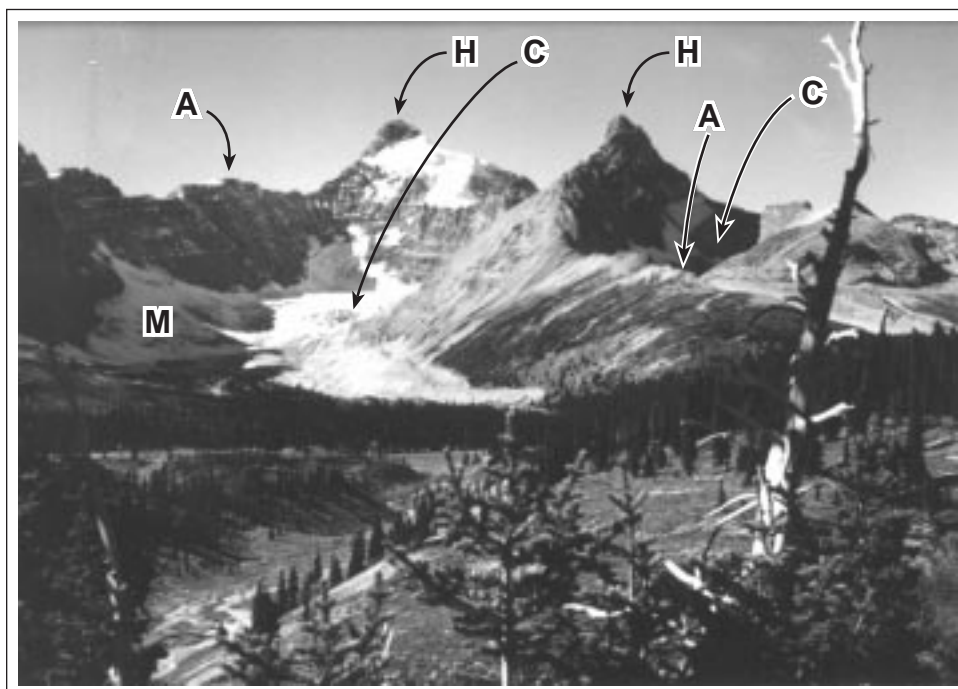
← 1 mark

d) At which type of plate boundary would fold type **K** most likely have been produced? (1 mark)

**Fold type K would have been at a convergent or subduction plate.**

← 1 mark

Refer to page vii of the Data Booklet.  
Use colour Photograph 5, along with the following  
black and white copy, to answer question 11.



11. a) Using the letters in the table below, label the following glacial features clearly on the black and white photograph above. **(2 marks)**

FEATURE	LETTER	
Horn	H	← $\frac{1}{2}$ mark
Arête	A	← $\frac{1}{2}$ mark
Cirque	C	← $\frac{1}{2}$ mark
Moraine	M	← $\frac{1}{2}$ mark

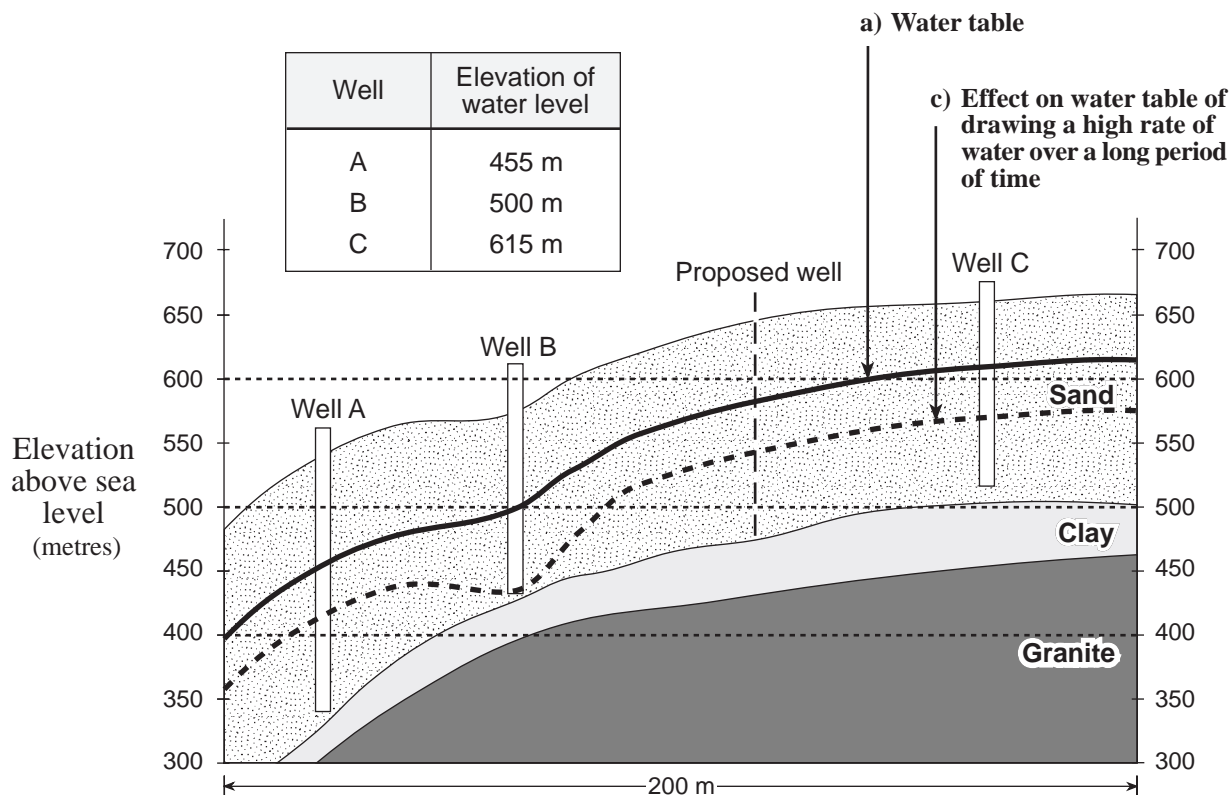
- b) As a result of the climatic conditions in the area in the photograph, the most common type of weathering is physical (mechanical) weathering. Name and describe the form of physical weathering that would **most likely** occur here. **(1 mark)**

Name: **Ice wedging/frost shattering/plucking/abrasion.** ←  $\frac{1}{2}$  mark

Description: **Water freezes in crack; expands as it crystallizes; force of expansion cracks rock.** } ←  $\frac{1}{2}$  mark



Use the following cross section to answer question 12.



12. a) Use a **solid** line to sketch on the cross section the level of the water table. Clearly label the water table on the diagram.

(2 marks)

See diagram.

← 2 marks

- b) At what elevation will the proposed well **likely** strike water?

(1 mark)

540 to 600 metres.

← 1 mark

- c) It is proposed that water be drawn from Well B at a very high rate for industrial use for a period of five years. Use a **dotted** line to sketch on the cross section the change in the total water table of the area that would result from this heavy extraction. Clearly label the change in the water table on the diagram.

(1 mark)

See diagram. There should be a cone of depression around well B and there may be a general lowering of the whole water table.

} ← 1 mark

13. Many scientists suggest that a large meteorite impact contributed to a mass extinction of plant and animal life on Earth 65 million years ago. Since that time, the earth's geological processes would have hidden most of the traces of such an impact, making it extremely difficult to find. Apart from the actual crater, describe **two** clues that might be found that would provide evidence of a large meteorite impact. **(2 marks)**

Any **two** of the following:

- **Impact cracks.**
- **Ejecta patterns.**
- **Increased level of iridium.**
- **Distortion in surrounding area.**
- **Circular basins, raised perimeter.**
- **Compressed rock, shock-glass pellets (due to impact).**
- **Central raised peak, characteristic of meteorite impact.**
- **Fragments of meteor.**

← **2 marks**

**END OF KEY**